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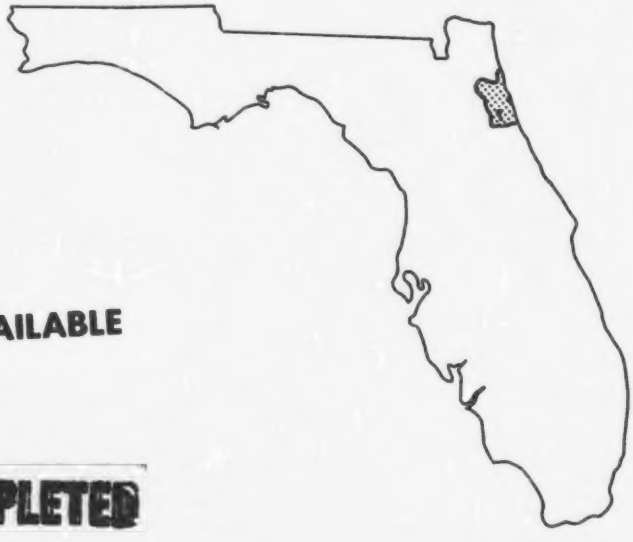
FLOOD INSURANCE STUDY

TOWN OF ST. AUGUSTINE BEACH, FLORIDA

ST. JOHNS COUNTY



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SEPTEMBER 2, 1988

ORIGINAL

Federal Emergency Management Agency

COMMUNITY NUMBER - 125146

NOTICE TO
FLOOD INSURANCE STUDY USERS

Communities participating in the National Flood Insurance Program have established repositories of flood hazard data for floodplain management and flood insurance purposes. This Flood Insurance Study may not contain all data available within the repository. It is advisable to contact the community repository for any additional data.

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FLOOD INSURANCE STUDY

TOWN OF ST. AUGUSTINE BEACH,
ST. JOHNS COUNTY,
FLORIDA

1.0 INTRODUCTION

1.1 Purpose of Study

This Flood Insurance Study revises and supersedes a previous Flood Insurance Rate Map for the Town of St. Augustine Beach, St. Johns County, Florida (Reference 1). This information will be used by the community to update existing floodplain regulations as part of the regular phase of the National Flood Insurance Program. The information will also be used by local and regional planners to further promote sound land use and floodplain development.

In some states or communities, floodplain management criteria or regulations may exist that are more restrictive or comprehensive than the minimum Federal requirements. In such cases, the more restrictive criteria take precedence and the state (or other jurisdictional agency) will be able to explain them.

This Flood Insurance Study was prepared by compiling existing hydrologic and hydraulic technical and scientific data prepared by the Federal Emergency Management Agency (FEMA) for purposes of the National Flood Insurance Program. The data were identified as the best available at the time of compilation of this Flood Insurance Study and should depict the general conditions of the flooding sources with relative accuracy. FEMA performed a cursory review and accepted the data as valid for purposes of this Flood Insurance Study and the National Flood Insurance Program. However, if better information is known to exist or has been developed since the date of this report, the information should be immediately forwarded to the Natural and Technological Hazards Division, FEMA, Atlanta, Georgia, for consideration for revision of this study.

1.2 Authority and Acknowledgments

The sources of authority for this Flood Insurance Study are the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973.

The hydrologic and hydraulic analyses for this study were obtained from a published Flood Insurance Study for the Unincorporated Areas of St. Johns County, Florida (Reference 2).

1.3 Coordination

On September 17, 1987, the results of this Flood Insurance Study were reviewed and accepted at a final coordination meeting attended by representatives of the community and FEMA.

2.0 AREA STUDIED

2.1 Scope of Study

This Flood Insurance Study covers the incorporated area of the Town of St. Augustine Beach, St. Johns County, Florida. The area of study is shown on the Vicinity Map (Figure 1).

The areas studied by detailed methods were selected based on the extent and validity of available existing hydrologic and hydraulic data. A detailed coastal flooding analysis was performed on the complete coastline of the Town of St. Augustine Beach, where the flooding source is the Atlantic Ocean.

2.2 Community Description

The Town of St. Augustine Beach is located in St. Johns County, Florida, and is bordered on the east by the Atlantic Ocean. The community is served by State Route 1A. The 1980 population of St. Augustine Beach was reported to be 1,289 (Reference 3).

The climate in the area is humid subtropical. The mean annual temperature of St. Augusture Beach is approximately 70 degrees Fahrenheit while the average annual precipitation in the region is approximately 53 inches with heaviest rains usually occurring during the summer months (Reference 2).

2.3 Principal Flood Problems

The major source of flooding in the community is storm surge generated in the Atlantic Ocean. High winds associated with tropical storms can produce high waves which can cause extensive damage (Reference 2).

September 10 to 11, 1964 (Hurricane Dora)

Hurricane Dora is the only storm of hurricane intensity to strike the northeastern Florida coast directly from the Atlantic Ocean in the last 100 years. This storm was accompanied by very heavy rainfall. Hurricane Dora moved inland over St. Augustine at about 12:15 a.m., September 10, and passed almost due west across northern Florida. Sustained winds were near 100 mph along the coastline from St. Augustine to the Jacksonville Beaches. Some homes in the area were flooded during the height of the storm, but the most severe damage, particularly to trees and utilities, occurred as a result of the intense winds. Actual flood damage was not great in spite of the relative severity of the storm. Hurricane tides were recorded at 12 feet National Geodetic Vertical Datum of 1929 (NGVD) and above at St. Augustine.

March 5 to 9, 1962

This storm was one of the most severe northeasters that has ever battered the east coast of the United States. Unlike a hurricane, which may pass over a coastal location in a fraction of a day, a northeaster is a severe

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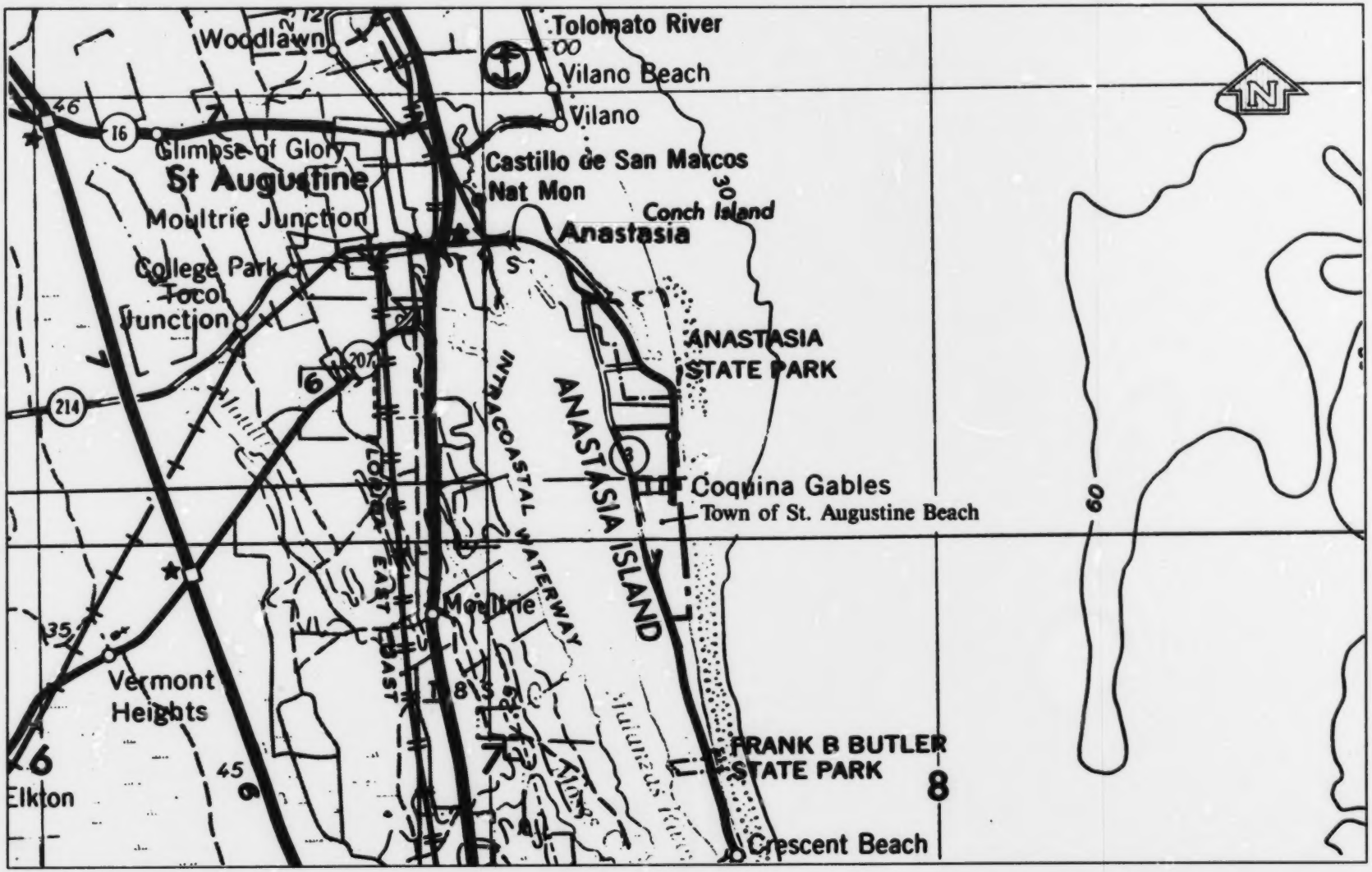

FIGURE 1

FEDERAL EMERGENCY MANAGEMENT AGENCY

TOWN OF ST. AUGUSTINE BEACH, FL
(ST. JOHNS CO.)

APPROXIMATE SCALE
2 0 2 4 6 MILES

VICINITY MAP

extratropical cyclone that may blow from the same direction and over long distances for several days. It caused severe damage from Long Island to the Outer Banks of North Carolina and significant damage to shorelines from Maine to Florida. Ocean tides at the Jacksonville Beaches were 1 to 2 feet above normal for a relatively long duration, but direct damage from flooding was not significant.

August 29 to September 13, 1960 (Hurricane Donna)

Hurricane Donna ranks as one of the great storms of the century and was termed the most destructive hurricane of all time in terms of damage to the entire State of Florida. The total damages in Florida were estimated at over $86 million. Approximately 80 percent of the total was property damage, the remaining being attributed to roads, streets, utilities, and agricultural damages. Total damages reported along the east coast, primarily in Duval, St. Johns, Flagler, and Volusia Counties on the upper coast and in Dade and Broward Counties on the lower coast, included nearly $4.6 million for urban damage and about $500,000 for damages to streets and roads. Hurricane tides were recorded at 5.7 feet NGVD at the Halifax River.

October 15 to 19, 1950

Originating over the western Caribbean Sea on October 15, this small but violent storm moved over eastern Cuba and directly over the City of Miami on October 17. During the day of October 18, the storm moved parallel to the Atlantic coast through the entire length of the state and passed into central Georgia. Highest wind gusts at Miami were 122 to 150 mph. Four persons were killed during the hurricane. High tides of 8 feet NGVD occurred along the coast from St. Augustine to Daytona Beach. Heavy seas eroded beaches as much as 50 feet. At Ormond, the Halifax River overflowed its banks and broke up storm-protection embankments. The tide in the Halifax River and the ocean at Daytona Beach, about 4 feet above normal, was reported to have been the highest since 1900. At the peak of the storm, tide levels at South Bridge were up to the bridge decking. Low areas in St. Augustine were flooded. The hurricane caused considerable damage to Jacksonville beaches and seawalls. High tides and waves overtopped seawalls and rolled up the ramps leading from the beach to the street, flooding many low areas along the beachfront. At Fernandina, where a tide elevation of 5.9 feet NGVD was observed, beach cottages and roads were undermined. Minor flooding occurred in the waterfront areas of downtown Jacksonville as high tides entered the St. Johns River.

August 24 to 29, 1949

Forming northeast of the Leeward Islands, this storm reached full hurricane intensity by the time it passed north of the Bahamas on August 26. It continued to increase in intensity as it approached the Florida coast, moving west-northwestward, and passed inland over the West Palm Beach-Delray Beach area. The calm center crossed the northeastern portion of Lake Okeechobee and passed east of Tampa. The storm recurred to the north and passed up the west coast of Florida into Georgia and North and

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South Carolina. Two persons were killed in Florida. The strongest winds and heaviest wind damages were in the vicinity of the City of Stuart and the Town of Jupiter, Florida. Hurricane tides of 5 feet NGVD were recorded at St. Augustine.

October 19, 1944

Originating in the Caribbean Sea, this large and severe hurricane entered the west coast near Sarasota, and passed to sea southeast of Jacksonville. The central core of damaging winds was 40 to 60 miles in diameter with winds reaching 65 mph. Extremely high tides occurred along the northeastern Florida shoreline; those tides produced comparatively high stages in the St. Johns River, but were not high enough to result in serious damage. The accompanying rainfall averaged almost 9 inches in the area. Damage was minor because of the limited development in the area. Hurricane tides of 7.9 feet NGVD were recorded at St. Augustine.

October 11 to 18, 1910

This hurricane originated in the western Caribbean Sea. After passing over Cuba, the storm center remained in the gulf, southwest of Key West, for three days. Recurring and moving northward, it passed inland near Sarasota, crossed the state, and entered the Atlantic Ocean near Fernandina. Waves were described as breaking over the seawalls and on the walls of Fort Marion in St. Augustine. Saltwater flooded the first floors of the houses on Bay View Drive. Homes along the waterfront were flooded but sustained little damage. Total damages in the city were noted as comparatively small. Storm damages were minor in the Jacksonville area. Hurricane tides of 7 to 8 feet NGVD were recorded at St. Augustine.

October 11 to 20, 1906

Following an unusual course, this hurricane passed over Cuba where it was reported to be a small but intense storm. Moving northeastward, the storm crossed the Florida Keys. After passing over Miami on October 18, its northeastward course was blocked by a high-pressure area on the North Atlantic coast, causing it to turn and then move southwestward back over Florida where it dissipated rapidly. Property damage in Miami was estimated at $100,000 and some damage was reported at St. Augustine.

2.4 Flood Protection Measures

The U.S. Weather Bureau is responsible for furnishing advance warnings when a hurricane is approaching and has a good chance of reaching a coastal area. The Weather Bureau also provides information on the conditions expected to occur within the hurricane, such as winds speeds, abnormal hurricane tides, probability and extent of flooding, and other pertinent data related to the storm. Advisories are widely disseminated to news agencies, radio and television stations, and responsible public officials (Reference 4).

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3.0 ENGINEERING METHODS

For the flooding sources studied in detail in the community, standard hydrologic and hydraulic study methods were used to determine the flood hazard data required for this study. Flood events of a magnitude that are expected to be equaled or exceeded once on the average during any 10-, 50-, 100-, or 500-year period (recurrence interval) have been selected as having special significance for floodplain management and for flood insurance rates. These events, commonly termed the 10-, 50-, 100-, and 500-year floods, have a 10-, 2-, 1-, and 0.2-percent chance, respectively, of being equaled or exceeded during any year. Although the recurrence interval represents the long-term average period between floods of a specific magnitude, rare floods could occur at short intervals or even within the same year. The risk of experiencing a rare flood increases when periods greater than 1 year are considered. For example, the risk of having a flood that equals or exceeds the 100-year flood (1-percent chance of annual exceedence) in any 50-year period is approximately 40 percent (4 in 10), and, for any 90-year period, the risk increases to approximately 60 percent (6 in 10). The analyses reported herein reflect flooding potentials based on conditions existing in the community at the time of completion of this study. Maps and flood elevations will be amended periodically to reflect future changes.

3.1 Hydrologic Analyses

Hydrologic analyses were carried out to establish the peak elevation-frequency relationships for each flooding source studied in detail.

Regionalized regression equations developed by the USGS in cooperation with the Florida Department of Transportation were used for deriving peak discharge-frequency relationships for the streams studied in detail (Reference 5). The hydrologic calculations for the study area are detailed in Tetra Tech's WRE NOTE-83-5 (Reference 6).

Inundation from the Atlantic Ocean caused by passage of storms (storm surge) was determined by the joint probability method (Reference 7). The storm populations were described by probability distributions of five parameters that influence surge heights. These parameters were central pressure depression (which measures the intensity of the storm), radius to maximum winds, forward speed of the storm, shoreline crossing point, and crossing angle. These characteristics were described statistically based on an analysis of observed storms in the vicinity of the Town of St. Augustine Beach. Primary sources of data for this analysis were the National Weather Service and the "Mariners Weather Log." The National Weather Service provided information on tropical cyclones of the North Atlantic Ocean from 1871 to 1977 and on storms from 1886 through 1979 (References 8-12). The Mariners Weather Log provided information on North Atlantic Tropical Cyclones in 1978 and 1979 (References 13 and 14). A summary of the parameters used for the area is presented in Table 1, Parameter Values for Surge Elevations.

For areas subject to flooding directly from the Atlantic Ocean, the FEMA standard storm surge model was used to simulate the coastal surge generated by any chosen storm (that is, any combination of the five storm

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CENTRAL PRESSURE DEPRESSION (MILLIBARS)	5	15	25	35	45	55	65	75	85	95
AVERAGE ASSIGNED PROBABILITIES*	0.222	0.222	0.222	0.117	0.072	0.044	0.056	0.024	0.007	0.014
STORM RADIUS TO MAXIMUM WINDS (NAUTICAL MILES)	15						30			
PROBABILITY	0.5938						0.4062			
FORWARD SPEED (KNOTS)	10				20		30			
PROBABILITIES: ENTERING ALONGSHORE EXITING	0.7895 0.8571 0.4706				0.2105 0.1429 0.3824		0.0 0.0 0.1470			
DIRECTION OF STORM PATH (DEGREES FROM TRUE NORTH)	ENTERING 250		295		ALONGSHORE 340		EXITING 25		70	
PROBABILITY	0.056		0.120		0.194		0.352		0.278	
FREQUENCY OF STORM OCCURRENCE (STORM/NAUTICAL MILE/YEAR)	$0.21(10^{-3})$		$0.64(10^{-3})$		$0.73(10^{-3})$		$1.87(10^{-3})$		$1.04(10^{-3})$	

*AVERAGE OF ENTERING, ALONGSHORE, AND EXITING PROBABILITIES

TABLE 1

FEDERAL EMERGENCY MANAGEMENT AGENCY

TOWN OF ST. AUGUSTINE BEACH, FL
(ST. JOHNS CO.)

PARAMETER VALUES FOR SURGE ELEVATIONS

parameters defined previously). By performing such simulations for a large number of storms, each of known total probability, the frequency distribution of surge height can be established as a function of coastal location. These distributions incorporate the large-scale surge behavior, but do not include an analysis of the added effects associated with much finer scale wave phenomena, such as wave height or runup. As the final step in the calculations, the astronomic tide for the region is then statistically combined with the computed storm surge to yield recurrence intervals of total water level (Reference 15).

The storm-surge elevations for the 10-, 50-, 100-, and 500-year floods have been determined for the Town of St. Augustine Beach and are shown in Table 2, Summary of Stillwater Elevations. The analyses reported herein reflect the stillwater elevations due to tidal and wind setup effects and include the contributions from wave action effects.

3.2 Hydraulic Analyses

Hydraulic analyses, considering storm characteristics and the shoreline and bathymetric characteristics of the flooding sources studied, were carried out to provide estimates of the elevations of floods of the selected recurrence intervals along each of the shorelines.

The FEMA storm surge model was used to simulate the hydrodynamic behavior of the surge generated by the various synthetic storms. This model uses a grid pattern approximating the geographical features of the study area and the adjoining areas. Surges were computed using grids of 5 nautical miles for the open coast computation and 1 nautical mile for the St. Augustine Inlet.

Underwater depths and land heights for the model grid systems were obtained from USGS topographic sheets (Reference 16) topographic maps (Reference 17). National Oceanic and Atmospheric Administration nautical Charts (Reference 18), State of Florida beach profiles (Reference 19), and from aerial photographs (References 20 and 21).

The methodology for analyzing the effects of wave heights associated with coastal storm surge flooding is described in a report prepared by the National Academy of Sciences (Reference 22). This method is based on the following major concepts. First, depth-limited waves in shallow water reach a maximum breaking height that is equal to 0.78 times the stillwater depth. The wave crest is 70 percent of the total wave height above the stillwater level. The second major concept is that wave height may be diminished by dissipation of energy due to the presence of obstructions, such as sand dunes, dikes and seawalls, buildings, and vegetation. The amount of energy dissipation is a function of the physical characteristics of the obstruction and is determined by procedures prescribed in Reference 21. The third major concept is that wave height can be regenerated in open fetch areas due to the transfer of wind energy to the water. This added energy is related to fetch length and depth.

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FLOODING SOURCE AND TRANSECT	FLOODING INSURANCE RATE MAP PANEL	STILLWATER ELEVATION (FEET NGVD)				ZONE	BASE FLOOD ELEVATION[1,2] (FEET NGVD)
		10-YEAR	50-YEAR	100-YEAR	500-YEAR		
ATLANTIC OCEAN							
1	0001,0002	N/A	N/A	8.9	N/A	AE VE	9–10 11–14
2	0002	N/A	N/A	8.6	N/A	AE VE	9–10 11–13

[1]ROUNDED TO THE NEAREST FOOT AND MAY INCLUDE EFFECTS OF WAVE ACTION
[2]DUE TO MAP SCALE LIMITATIONS, BASE FLOOD ELEVATIONS SHOWN ON MAP MAY REPRESENT AVERAGE ELEVATIONS FOR THE ZONES DEPICTED

TABLE 2

FEDERAL EMERGENCY MANAGEMENT AGENCY

TOWN OF ST. AUGUSTINE BEACH, FL
(ST. JOHNS CO.)

SUMMARY OF STILLWATER ELEVATIONS

ATLANTIC OCEAN

Wave heights were computed along transects (cross-section lines) that were located along the coastal areas, as illustrated in Figure 2, Transect Location Map, in accordance with the "Users Manual for Wave Height Analysis" (Reference 23). The transects were located with consideration given to the physical and cultural characteristics of the land so that they would closely represent conditions in their locality. Transects were spaced close together in areas of complex topography and dense development. In areas having more uniform characteristics, they were spaced at large intervals. It was also necessary to locate transects in areas where unique flooding existed and in areas where computed wave heights varied significantly between adjacent transects.

Each transect was taken perpendicular to the shoreline and extended inland to a point where wave action ceased. Along each transect, wave heights and elevations were computed considering the combined effects of changes in ground elevation, vegetation, and physical features. The stillwater elevations for the 100-year flood were used as the starting elevations for these computations. Wave heights were calculated to the nearest 0.1 foot, and wave elevations were determined at whole-foot increments along the transects. The location of the 3-foot breaking wave for determining the terminus of the V zone (area with velocity wave action) was also computed at each transect. Table 3 provides a listing of the transect locations and stillwater starting elevations, as well as initial wave crest elevations.

TABLE 3 - TRANSECT LOCATIONS, STILLWATER STARTING ELEVATIONS, AND INITIAL WAVE CREST ELEVATIONS

TRANSECT	LOCATION	ELEVATION (FEET) STILLWATER	ELEVATION (FEET) WAVE CREST
1	From the Atlantic coastline, about 3.6 miles south of St. Augustine Inlet, running 500 feet east to west	8.9	13.8
2	From the Atlantic coastline, about 6.4 miles south of the St. Augustine Inlet running east to west about 500 feet	8.6	13.3

Figure 3 represents a sample transect that illustrates the relationship between the stillwater elevation, the wave crest elevation, the ground elevation profile, and the location of the V/A zone boundary.

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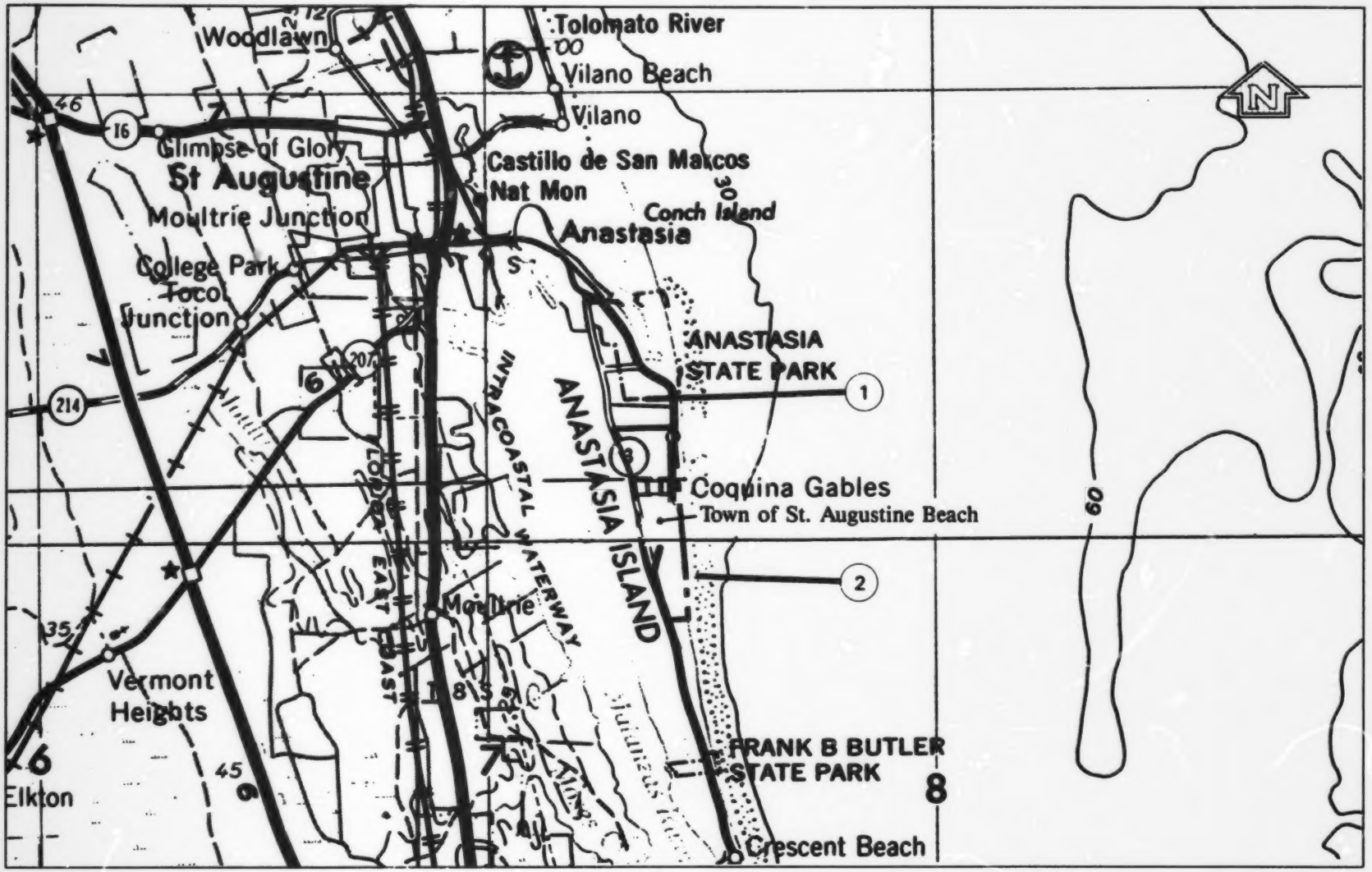

FIGURE 2

FEDERAL EMERGENCY MANAGEMENT AGENCY

TOWN OF ST. AUGUSTINE BEACH, FL
(ST. JOHNS CO.)

APPROXIMATE SCALE
2 0 2 4 6 MILES

TRANSECT LOCATION MAP

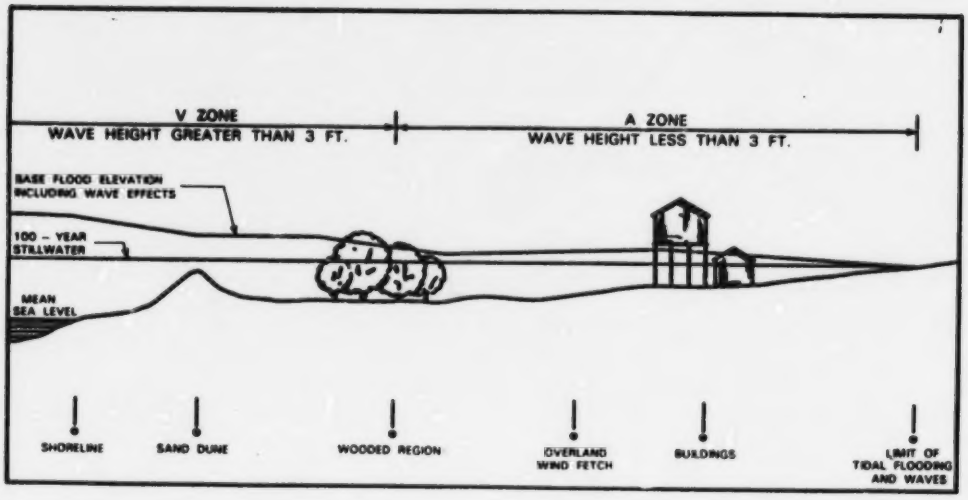

FIGURE 3 - Transect Schematic

After analyzing wave heights along each transect, wave elevations were interpolated between transects. Various source data were used in the interpolation, including topographic maps (References 16 and 17), beach profiles (Reference 19), aerial photographs (References 20 and 21), and engineering judgment. Controlling features affecting the elevations were identified and considered in relation to their positions at a particular transect and their variation between transects.

All elevations are referenced to the NGVD.

4.0 FLOODPLAIN MANAGEMENT APPLICATIONS

The National Flood Insurance Program encourages state and local governments to adopt sound floodplain management programs. Therefore, each Flood Insurance Study provides 100-year flood elevations and delineations of the 100- and 500-year floodplain boundaries to assist communities in developing floodplain management measures.

4.1 Flood Boundaries

To provide a national standard without regional discrimination, the 1-percent annual chance (100-year) flood has been adopted by FEMA as the base flood for floodplain management purposes. The 0.2-percent annual chance (500-year) flood is employed to indicate additional areas of flood risk in the community. For each flooding source studied in detail, the 100- and 500-year floodplain boundaries have been delineated using the flood elevations determined at each transect. Between intersects, the boundaries were interpolated using topographic maps at scales of 1:24000 and 1:1200, with contour intervals of 5 and 2 feet, respectively (References 16 and 17).

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The 100- and 500-year floodplain boundaries are shown on the Flood Insurance Rate Map. On this map, the 100-year floodplain boundary corresponds to the boundary of the areas of special flood hazards (Zones A, AE, AH, AO, A99, V, and VE) and the 500-year floodplain boundary corresponds to the boundary of areas of moderate flood hazards. In cases where the 100- and 500-year floodplain boundaries are close together, only the 100-year floodplain boundary has been shown. Small areas within the floodplain boundaries may lie above the flood elevations but cannot be shown due to limitations of the map scale and/or lack of detailed topographic data.

5.0 INSURANCE APPLICATION

For flood insurance rating purposes, flood insurance zone designations are assigned to a community based on the results of the engineering analyses. These zones are as follows:

Zone AE

Zone AE is the flood insurance rate zone that corresponds to the 100-year floodplains that are determined in the Flood Insurance Study by detailed methods. Whole-foot base flood elevations derived from the detailed hydraulic analyses are shown at selected intervals within this zone.

Zone VE

Zone VE is the flood insurance rate zone that corresponds to the 100-year coastal floodplains that have additional hazards associated with storm waves. Whole-foot base flood elevations derived from the detailed hydraulic analyses are shown at selected intervals within this zone.

Zone X

Zone X is the flood insurance rate zone that corresponds to areas outside the 100-year floodplain, areas of 100-year flooding where average depths are less than 1 foot, areas of 100-year flooding where the contributing drainage area is less than 1 square mile, and areas protected from the 100-year flood by levees. No base flood elevations or depths are shown within this zone.

6.0 FLOOD INSURANCE RATE MAP

The Flood Insurance Rate Map is designed for flood insurance and floodplain management applications.

For flood insurance applications, the map designates flood insurance rate zones as described in Section 5.0 and, in the 100-year floodplains that were studied by detailed methods, shows selected whole-foot base flood elevations or average depths. Insurance agents use the zones and base flood elevations in conjunction with information on structures and their contents to assign premium rates for flood insurance policies.

For floodplain management applications, the map shows by tints, screens, and symbols the 100- and 500-year floodplains.

7.0 OTHER STUDIES

A Flood Insurance Study has been prepared for the Unincorporated Areas of St. Johns County, Florida (Reference 2) and is in agreement with this study.

Due to its more detailed analysis, this Flood Insurance Study supersedes the previously printed Flood Hazard Boundary Map for the Town of St. Augustine Beach, St. Johns County, Florida (Reference 24) and the previously published Flood Insurance Rate Map for the Town of St. Augustine Beach (Reference 1).

8.0 LOCATION OF DATA

Information concerning the pertinent data used in the preparation of this study can be obtained by contacting the Natural and Technological Hazards Division, FEMA, 1371 Peachtree Street, NE., Suite 736, Atlanta, Georgia 30309.

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